

SCIENCE BULLETIN OF JOSAI UNIVERSITY

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PART I ANNUAL REPORTS

1. Abstracts of Papers Published in Journals

MATHEMATICS

An elementary approach to the Gauss hypergeometric function

T. Oshima

Josai Mathematical Monographs **6**, 3-23 (2013).

We give an introduction to the Gauss hypergeometric function, the hypergeometric equation and their properties in an elementary way. Moreover we explicitly and uniformly describe the connection coefficients, the reducibility of the equation and the monodromy group of the solutions.

Classification of Fuchsian systems and their connection problem

T. Oshima

RIMS Kokyuroku Bessatu **B37**, 163-192 (2013).

We review Deligne-Simpson problems, a combinatorial structure of middle convolutions and their relation to Kac-Moody root systems pointed out by Crawley-Boevey. We show that the Fuchsian systems with a fixed number of accessory parameters are reduced to finite number of basic systems by middle convolutions. In the last section we give an explicit connection formula for solutions of Fuchsian differential equations without moduli.

Boundary value problems on Riemannian symmetric spaces of the non-compact type

T. Oshima and N. Shimeno* (* School of Science and Technology, Kwansei Gakuin University)
Lie Groups: Structure, Actions, and Representations, Prog. Math. **307**, 273-308, Birkhauser, ISBN 978-1-4614-7192-9 (2013).

We characterize the image of the Poisson transform on any distinguished boundary of a Riemannian symmetric space of the noncompact type by a system of differential equations. The system corresponds to a generator system of a two sided ideals of an universal enveloping algebra, which are explicitly given by analogues of minimal polynomials of matrices.

A quantization of linear algebra and its application to integral geometry

H. Oda* and T. Oshima (* Takushoku University)

Geometric Analysis and Integral Geometry, Contemporary Mathematics **589**, 189-208, ISSN: 0271-4132 (2013).

In order to construct good generating systems of two-sided ideals in the universal enveloping algebra of a complex reductive Lie algebra, we quantize some notions of linear algebra, such as minors, elementary divisors, and minimal polynomials. The resulting systems are applied to the integral geometry on various homogeneous spaces of related real Lie groups.

Finite multiplicity theorems

T. Kobayash* and T. Oshima (* Graduate School of Mathematics, University of Tokyo)
Adv. Math. **248**, 912-944 (2013).

We find upper and lower bounds of the multiplicities of irreducible admissible representations π of a semisimple Lie group G occurring in the induced representations $\text{Ind}_H^G \tau$ from irreducible representations τ of a closed subgroup H . As corollaries, we establish geometric criteria for finiteness of the dimension of $\text{Homo}_G(\pi, \text{Ind}_H^G \tau)$ (induction) and of $\text{Homo}_H(\pi|_H, \tau)$ (restriction) by means of the real flag variety G/P , and criteria for uniform boundedness of these multiplicities by means of the complex flag variety.

Estimating the Variance of the Square of Canonical Process

Kakuzo Iwamura and Youlei Xu* (* Tsinghua University, Beijing, China)
Applied Mathematical Sciences, **7**, 3731-3738 (2013).

Canonical process, as an important kind of uncertain process, has been applied to uncertain calculus, uncertain differential equation and uncertain finance. This paper gives an estimation of the variance of the square of canonical process.

Coupon collector's problems with statistical applications to rankings

Aki, S* and Hirano, K. (* Department of Mathematics, Kansai University)
Annals of the Institute of Statistical Mathematics, **65**, 571-587 (2013).

Some new exact distributions on coupon collector's waiting time problems are given based on a generalized Polya urn sampling. In particular, usual Polya urn sampling generates an exchangeable random sequence. In this case, an alternative derivation of the distribution is also obtained from de Finetti's theorem. In coupon collector's waiting time problems with m kinds of coupons, the observed order of m kinds of coupons corresponds to a permutation of m letters uniquely. Using the property of coupon collector's problems, a statistical model on the permutation group of m letters is proposed for analyzing ranked data. In the model, as the parameters mean the proportion of the m kinds of coupons, the observed ranking can be intuitively understood. Some examples of statistical inference are also given. (AISM, Abstract)

CHEMISTRY

Theoretical Study on the Reaction Mechanism of Formation of Lutidine Derivatives — Unexpected FLUORAL-P Compounds —

Hiroyuki Teramae, Yasuko Y. Maruo^{*1}, Jiro Nakamura^{*1}, (*1 NTT Energy & Environmental Labs., Japan)

IEICE Trans. Electronics., **E96C**, 383-384 (2013)

The reaction path from acetyl acetone (pentane-2,4-dione) to lutidine derivative is calculated at the HF/3-21G+ZPC level (ZPC=zero point energy correction), and MP2/6-31G**+ZPC level. As a model for porous glass, $\text{H}_2\text{Si}=\text{O}$ and $(\text{OH})_2\text{Si}=\text{O}$ make chemical bonds or strong complex with FLUORAL-P that decrease the activation energy of a H_2O elimination reaction.

Theoretical study on the reaction mechanism of formation of 3,5-diacetyl-1,4-dihydrolutidine

Hiroyuki Teramae, Yasuko Y. Maruo^{*1} (*1 NTT Energy & Environmental Labs., Japan)

Intern. J. Quantum Chem., **113**, 393-396 (2013)

We have studied the reaction path of the formation of 3,5-diacetyl-1,4-dihydrolutidine (DL1), 3,5-dibenzoyl-1,4-dihydro-2,6-dimethylpyridine, and 2,6-dibenzoyl-1,4-dihydro-3,5-dimethylpyridine with the *ab initio* molecular orbital method at HF/3-21G and HF/6-31G(d,p) levels. For DL1, we also calculated at MP2/6-31G(d,p) level. The barrier heights of H_2O elimination elementary reactions are about 50-60 kcal/mol and quite high in the gas phase, however, this is well agreed with the experimental results that the reaction proceeds in aqueous solutions.

Electronic states of mixed base pairs systems of dna and the effect of base composition and sequences on the band structures using screw axis translational symmetry

Peng Xie^{*1}, Hiroyuki Teramae, Kai Liu, Yuriko Aoki^{*1} (*1 Kyushu University)

Intern. J. Quantum Chem., **113**, 489-496 (2013)

We perform the conventional band structure and local density of states (LDOS) calculations in the vicinity of the Fermi level at *ab initio* molecular orbital level with 6-31G base set for one DNA duplex with repeated mononucleotide sequences and four DNA duplexes with repeated dinucleotide sequences in B form neutralized by Na^+ . The LDOS of six other DNA duplexes with repeated trinucleotide sequences in the same states are analyzed. The obtained results are compared with those by the band calculations based on periodic boundary condition using screw axis symmetry. The investigations focused on the influence of the base composition and base sequence on the DNA conductivity. The band structure and

LDOS calculation results indicated that base guanine is more important for DNA conductivity than the other bases, and DNA conductivity varies with base sequence of DNA. Moreover, poly (dG) • poly (dC) shows the best conductor in our DNA duplex models.

Reply to the comment of J. Ladik on “electronic states of mixed base pairs systems of DNA and the effect of base composition and sequences on the band structures using screw axis translational symmetry”

Peng Xie^{*1}, Hiroyuki Teramae, Kai Liu, Yuriko Aoki^{*1} (*1 Kyushu University)
Intern. J. Quantum Chem., **114**, 303 (2013)

Three-Dimensional Visualization of Wave Functions for Rotating Molecule: Plot of Spherical Harmonics

Shin-ichi Nagaoka^{*1}, Hiroyuki Teramae, Umpei Nagashima^{*2} (*1 Ehime University, *2 National Institute of Advanced Industrial Science and Technology)
J. Chem. Educ., **90**, 669-670 (2013)

Wave functions for rotating diatomic molecules (spherical harmonics) were three-dimensionally visualized by using Graph-R in tandem with Excel.

Pt クラスター上での水素分子解離

寺前裕之, 伊藤裕哉, 長嶋雲兵^{*1} (*1 産総研)
J. Comp. Chem. Japan, **12**, 133-137 (2013)

Pt_n (n=1-4) クラスターを用い, RHF/LANL2DZ レベルで水素分子 H₂ の 1 重項状態での解離反応の反応経路を求めることを試みた。Pt₁-Pt₃ クラスターに対しては, 水素原子の解離・吸着を表すようなポテンシャル面は得られなかった。一方, Pt₄ クラスターにおいては, 水素原子の解離・吸着を示すポテンシャル面が得られ, 水素分子の解離・吸着の反応過程を再現するには Pt₄ 以上のクラスターが必要なことがわかった。

計算された H₂⁻ の基底状態 ²Σ_u⁺ の構造 —— 基底関数依存性 ——

Amih SAGAN^{*1}, 中山 尚史^{*2}, 長嶋 雲兵^{*1}, 寺前 裕之, 長岡 伸一^{*3} (*1 産総研, *2 コンプレックス, *3 愛媛大院理)
J. Comp. Chem. Japan, **12**, 190-195 (2013)

Gaussian03 に標準的に納められている基底関数系 (6-311G**, 6-311++G**, aug-cc-pVTZ, cc-pVTZ, D95, D95++) を用いて diffuse 関数の有無による H₂⁻ の基底状態 ²Σ_u⁺ の構造の基底関数依存性を示す。計算方法は HF 法および MP2 法, そして Full CI 法である。diffuse 関数を含まない通常の基底関数系では, H₂⁻ は H₂ の反結合性軌道に電子が入るので, H₂⁻ の基底状態 ²Σ_u⁺ の核

間距離は H_2 の核間距離に比べ大きくなる。diffuse 関数を含む基底関数系を用いると電子は大きく広がった軌道に入るため H_2^- の基底状態 $^2\Sigma_u^+$ の構造は H_2 の構造に近い構造となる。 H_2^- の基底状態 $^2\Sigma_u^+$ の構造と diffuse 関数の ζ ($\langle r \rangle$) の関係も示した。diffuse 関数の ζ が大きく $\langle r \rangle$ が小さいとき、 H_2^- の基底状態 $^2\Sigma_u^+$ の構造は H_2 のそれより長くなり、diffuse 関数の ζ が小さく $\langle r \rangle$ が大きいとき、 H_2^- の基底状態 $^2\Sigma_u^+$ の構造は H_2 のそれに近くなる。

1s 電子が作る半結合と単結合

Amih SAGAN^{*1}, 田島澄恵^{*2}, 中山尚史^{*3}, 長嶋雲兵^{*1}, 寺前裕之, 長岡伸一^{*4} (*1 産総研, *2 ヒューリンクス, *3 コンプレックス, *4 愛媛大院理)

J. Comp. Chem. Japan, **12**, 230-234 (2013)

1s 電子により結合を形成する H_2^+ , H_2 , HeH^+ , He_2^+ , He_2^{2+} について、平衡核間距離とポテンシャルエネルギー曲面、および軌道相互作用を解析した。平衡核間距離は、UMP2/6-311++G** レベルでそれぞれ 1.0496, 0.738, 0.785, 1.086, 0.712 Å (1 Å = 10^{-10} m) であり、それぞれの大小関係を電子反発と軌道相互作用で説明することができた。但し He_2^+ の核間距離が He_2^{2+} より長いのは、 He_2^{2+} の反結合性軌道に電子が入ったためと考えられるが、 H_2^+ より短いので、He の 1s の半径が H のそれに比べて短いことに起因している可能性もある。

Enhancement of the solubility, thermal stability, and electronic properties of carbon nanotubes functionalized with MEH-PPV: A combined experimental and computational study,”

Pongthep Prajongtat^{*1}, Songwut Suramitr^{*1}, Matthew Paul Gleeson^{*1}, Koichiro Mitsuke, Supa Hannongbua^{*1} (*1 Department of Chemistry, Kasetsart University)

Monatshefte für Chemie, **144**, 925-935 (2013).

Multiwalled carbon nanotubes functionalized with poly[2-methoxy-5-(2-ethylhexyloxy)-1,4-phenylenevinylene] (MWCNT-f-MEH-PPV) nanocomposites were successfully prepared by employing a “grafting from” approach. The content of the functionalizing MEH-PPV in the composites was observed as 76 wt.%. Compared with pristine MWCNTs (p-MWCNT), the aqueous solubility and thermal stability of the former are significantly enhanced. The effect of covalently and noncovalently functionalized nanotubes on dye-sensitized solar cell performance was also studied. Solar cells were successfully fabricated from isolated MEH-PPV, p-MWCNT/MEH-PPV, and MWCNT-f-MEH-PPV/MEH-PPV counterelectrodes. The devices based on an MWCNT-f-MEH-PPV/MEH-PPV counterelectrode demonstrated the best photovoltaic performance as observed by higher J_{SC} , V_{OC} , and fill factor (FF) values. The experimental phenomena can be explained by quantum-chemical calculations: Charge transfer from MEH-PPV oligomers to nanotubes is greater when covalently functionalized compared with noncovalently functionalized. This suggests that the improvement in the photovoltaic parameters of the cells containing covalently functionalized nanotubes results not only from the higher concentration present in the nanotube films of the counterelectrode, but also from the greater electron delocalization between the oligomers and nanotubes.

Inferring the evolution of teleostean zp genes based on their sites of expression

Kaori Sano, Mari Kawaguchi^{*1}, Satoshi Watanabe^{*2}, Yoshitomo Nagakura^{*3}, Takashi Hiraki^{*1}, Shigeki Yasumasu^{*1} (*1 Department of Science and Technology, Sophia University, *2 Japan International Research Center for Agricultural Sciences, *3 Tohoku National Fisheries Research Institute, Fisheries Research Agency)

Journal of Experimental Zoology Part B: Molecular Developmental Evolution **320**, 332-343 (2013)

Fish egg envelopes consist of several glycoproteins, called zona pellucida (ZP) proteins, which are conserved among chordates. Euteleosts synthesize ZP proteins in the liver, while elopomorphs synthesize them in the ovaries. In Cypriniformes, zp genes are expressed in the ovaries. We investigated the zp genes of two Otocephalan orders: Clupeiformes (Pacific herring and Japanese anchovy) and Gonorynchiformes (milkfish), which diverged earlier than Cypriniformes. cDNA cloning of zp gene homologs revealed that Pacific herring and Japanese anchovy possessed both ovary- and liver-expressed zp genes; however, the zp genes of milkfish were only expressed in the ovaries. Molecular phylogenetic analysis showed that ovary- and liver-expressed zpc genes of two the Clupeiformes formed independent clades. Based on this, we hypothesized the evolution of teleostean zp genes, focusing on the organ expressing zp gene. As in other chordates, the original site of expression of zp genes was likely the ovary. In the early stage of teleostean evolution, the ancestral zp genes acquired the ability to express in the liver. Later, one of the two expression sites became dominant. The liver – expressed zp genes are component proteins of the egg envelope in the Euteleostei. In Otocephala, Clupeiformes possess both ovary- and liver-expressed genes that presumably participate in egg envelope formation, whereas the Gonorynchiformes and Cypriniformes have primarily preserved ovary expressed zp genes.

Adaptive evolution of fish hatching enzyme: one amino acid substitution results in differential salt dependency of the enzyme

Mari Kawaguchi^{*1,*2}, Shigeki Yasumasu^{*3}, Akio Shimizu^{*4}, Norio Kudo^{*5}, Kaori Sano, Ichiro Iuchi^{*3}, Mutsumi Nishida^{*1} (*1 Atmosphere and Ocean Research Institute, The University of Tokyo, *2 Research Fellow of the Japan Society for the Promotion of Science (JSPS), *3 Department of Materials and Life Sciences, Faculty of Science and Technology, Sophia University, *4 National Research Institute of Fisheries Science, Fisheries Research Agency, *5 Seed Compounds Exploratory Unit for Drug Discovery Platform, RIKEN Advanced Science Institute)

The Journal of Experimental Biology **216**, 1609-1615 (2013)

Embryos of medaka *Oryzias latipes* hatch in freshwater, while those of killifish *Fundulus heteroclitus* hatch in brackish water. Medaka and *Fundulus* possess two kinds of hatching enzymes, high choriolytic enzyme (HCE) and low choriolytic enzyme (LCE), which

cooperatively digest their egg envelope at the time of hatching. Optimal salinity of medaka HCE was found in 0 mol l⁻¹ NaCl, and activity decreased with increasing salt concentrations. One of the two *Fundulus* HCEs, FHCE1, showed the highest activity in 0 mol l⁻¹ NaCl, and the other, FHCE2, showed the highest activity in 0.125 mol l⁻¹ NaCl. The results suggest that the salt dependencies of HCEs are well adapted to each salinity at the time of hatching. Different from HCE, LCEs of both species maintained the activity sufficient for egg envelope digestion in various salinities. The difference in amino acid sequence between FHCE1 and FHCE2 was found at only a single site at position 36 (Gly/Arg), suggesting that this single substitution causes the different salt dependency between the two enzymes. Superimposition of FHCE1 and FHCE2 with the 3-D structure model of medaka HCE revealed that position 36 was located on the surface of HCE molecule, far from its active site cleft. The results suggest a hypothesis that position 36 influences salt-dependent activity of HCE, not with recognition of primary structure around the cleavage site, but with recognition of higher ordered structure of egg envelope protein.

SERS microscopic imaging as novel tool for assessing viability and enumerating yeast cells at various stages of cell cycle in lag, log, exponential and stationary phases of growth in culture

Manikantan Syamala Kiran^{*1,*2}, Tamitake Itoh^{*2}, Hiroko Abe^{*2}, Yasuko Fujita^{*2}, Kazuya Tomimoto^{*2}, Vasudevanpillai Biju^{*2}, Sajani Kavitha^{*3}, Arumugham Ganamani^{*3}, Mitsuru Ishikawa (*1 Biomaterials Division, CSIR-CLRI, Adyar, Chennai, 600020, India, *2 Nanobioanalysis Group, Health Research Institute, National Institute of Advanced Industrial Science and Technology (AIST), Takamatsu, Kagawa, Japan, *3 Microbiology Division, CSIR-CLRI, Adyar, Chennai, India)

J. Exp. Nanosci. **8**, 1-12 (2013)

Surface enhanced Raman scattering (SERS) microscopic imaging was employed to enumerate the yeast cells in culture. We found this imaging method as an efficient tool for easily differentiating and quantitatively enumerating yeast cell at different stages of cell-division cycle (G1, S, G2 and M phase) at various stages of growth phases namely lag, log, exponential and stationary phases in culture. Apart from enumerating the cells at different stages of cell cycle under lag, log, exponential and stationary phases, it was possible using SERS microscopy to differentiate the live cells from dead ones. The dead cells were SERS inactive and gave enhanced autofluorescence compared with the live cells, which were SERS active. The results from the present investigation suggest that SERS microscopic imaging, using silver nanoparticles (AgNPs) as a sensitive tool to enumerate the yeast cells in culture.

Effects of Interactions with Cyclic Solvent Molecules on Optical Dephasing of CdSe/ZnS Colloidal Quantum Dots Detected by Femtosecond Four-Wave Mixing Spectroscopy

Yusuke Hirosawa^{*1}, Hiroyoshi Kouzai^{*1}, Naoya Yamazaki^{*1}, Hayato Miyagawa^{*1}, Noriaki

Tsurumachi^{*1}, Shun Koshiba^{*1}, Shunsuke Nakanishi^{*1}, Vasudevan Pillai Biju^{*2,*3} and Mituru Ishikawa (*1 Department of Advanced Materials Science, Kagawa University, Takamatsu 761-0396, Japan, *2 Health Research Institute, National Institute of Advanced Industrial Science and Technology, Takamatsu 761-0395, Japan, *3 Precursory Research for Embryonic Science and Technology (PRESTO), Japan Science and Technology Agency (JST), Chiyoda, Tokyo 102-0076, Japan)
Jpn. J. Appl. Phys. **52**, 070202 (2013).

We have studied the effects of interactions with cyclic solvent molecules on the optical dephasing of CdSe/ZnS colloidal quantum dots (QDs) by femtosecond four-wave mixing spectroscopy. We have found that the interactions with the cyclic solvents without π -bonds result in unexpectedly long dephasing times of QDs even at room temperature, while the interactions with the cyclic solvents including π -bonds make the optical dephasing of QDs extremely fast with a dephasing time of less than our time resolution.

Single Femtosecond Laser Pulse-Single Crystal Formation of Glycine at the Solution Surface

Tsung-Han Liu^{*1}, Takayuki Uwada, Teruki Sugiyama^{*2}, Anwar Usman^{*1}, Yoichiro Hosokawa^{*3}, Hiroshi Masuhara^{*1}, Ting-Wei Jiang^{*4}, and Chung-Jung Chen^{*4} (*1 Department of Applied Chemistry and Institute of Molecular Science, National Chiao Tung University, Taiwan, *2 Instrument Technology Research Center, National Applied Research Laboratories, Taiwan, *3 Graduate School of Materials Science, Nara Institute of Science and Technology, *4 Life Science Group, Scientific Research Division, National Synchrotron Radiation Research Center, Taiwan)
J. Cryst. Growth, **366**, 101-106 (2013)

We demonstrate femtosecond laser-induced crystallization of glycine from its supersaturated solution depending on laser tunable parameters (pulse energy and repetition rate) and focal position, and examine the crystallization probability, crystal morphology, and crystal polymorph. The generation of cavitation bubble through multiphoton absorption of water depends on input laser pulse energy and repetition rate, which strongly determine morphology and number of the obtained crystals. Significant increase in the crystallization probability is observed by irradiating the femtosecond laser pulses to the air/solution interface, and single pulse-induced single crystal formation is successfully achieved. The crystallization mechanism is discussed in view of inhomogeneous mechanical stress induced by cavitation bubble generation and molecular assembly characteristics of the surface.

Polarization and Droplet Size Effects in the Laser-Trapping-Induced Reconfiguration in Individual Nematic Liquid Crystal Microdroplets

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Taiwan)

J. Phys. Chem. B, **117**, 4536-4540 (2013)

We experimentally demonstrate reordering throughout the inside of an individual bipolar nematic liquid-crystalline microdroplet optically trapped by a highly focused laser beam, when the laser powers are above a definite threshold. The threshold depends on the droplet size and laser polarization. A physical interpretation of the results is presented by considering the nonlocal orientations of the nematic liquid-crystal molecules in the droplets with the dimensions on the order of the focal spot diameter or larger. On the basis of the finite size approximation, we show that the dependence of threshold power on the droplet size is calculated to be in qualitative agreement with the experimental data.

Rayleigh Scattering Correlation Spectroscopy on Diffusion Dynamics of Nanoparticles Under Intense Laser Irradiation

Ping-Yu Hee^{*1}, Takayuki Uwada, Kazunori Okano^{*}, Atsushi Miura^{*}, Hiroshi Masuhara^{*1}
(*1 Department of Applied Chemistry and Institute of Molecular Science, National Chiao Tung University, Taiwan)

Proc. SPIE, **8810**, 88102T1-12 (2013)

Rayleigh scattering correlation microspectroscopy is developed and applied to study diffusion dynamics of some nanospheres in water. It was clearly found that the diffusion constant of gold nanoparticles decreased with increasing excitation laser power at the excitation wavelength of higher absorption cross section. This behavior was explained in terms of a coupling between laser trapping by the scattering excitation laser itself and laser heating of the particle. In the case of non-absorbing nanospheres such as silica and polystyrene, the excitation power dependence can be ascribed only to the laser trapping. Experimental setup is introduced, theoretical formulation is described, and future development of this measurement is considered.

Bent CNN bond of diazo compounds, $RR' (C = N^+ = N^-)$

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J. Mol. Struct., **1034**, 346-353 (2013).

The reaction of ninhydrin with benzophenone hydrazone afforded 2-diazo-3-diphenyl-methylenehydrazono-2-indanone **1** and 2-diazo- 1,3-bis(diphenylmethylenehydrazono)indane **2**. X-ray crystal structure analyses of these products showed that the diazo functional group $C = N^+ = N^-$ of **1** is bent by 173.9° , while that of **2** has a linear geometry. The crystal structure data of diazo compounds have been retrieved from the Cambridge Structural Database (CSD),

which hit 177 entries to indicate that the angle of 173.9° in **1** lies in one of the most bent structures. The CSD search also indicated that diazo compounds consisting of a distorted diazo carbon tend to bend the $C=N^+=N^-$ bond. On the basis of DFT calculations (B3LYP/6-311++G(d,p)) of model compounds, it was revealed that the bending of the CNN bond is principally induced by steric factors and that the neighboring carbonyl group also plays a role in bending toward the carbonyl side owing to an electrostatic attractive interaction. The potential surface along the path of $C=N^+=N^-$ bending in 2-diazopropane shows a significantly shallow profile with only 4 kcal/mol needed to bend the $C=N^+=N^-$ bond from 180° to 160° . Thus, the bending of the diazo group in **1** is reasonable as it is provided with all of the factors for facile bending disclosed in this investigation.

Thermal and photochemical rearrangements of 3-arylamino-2-phenyl-1H-inden-1-ones to N-arylphthalimides

M. Kawai, E. Sakanoshita, M. Akita, and K. Kobayashi

Heterocycles, **87**, 1289–1299 (2013).

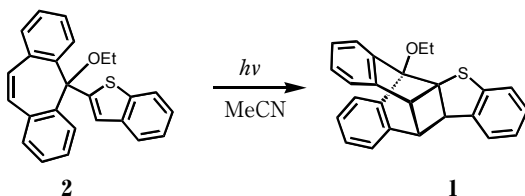
Upon heating to above their melting temperatures, 3-arylamino-2-phenyl-1H-inden-1-ones and 2,2'-diphenyl-3,3'-bis(arylimino)-[2,2'-bi-1H-indene]-1,1'-dione undergo a skeletal rearrangement to afford N-arylphthalimides along with benzoic acid in the presence of atmospheric oxygen. The photoreaction of these compounds in acetonitrile also results in the formation of these products. The mechanism of the reactions, including the formation of a peroxy radical followed by its conversion to a nitrogen-centered radical, is proposed.

Intramolecular $[2\pi + 2\pi]$ -photocyclization and conformational preference of 5-(2-benzo[b]thienyl)-5-ethoxy-5H-dibenzo[a,d]cycloheptene

M. Akita, S. Mohri, M. Takahashi, and K. Kobayashi

Heterocycles, **87**, 1319–1326 (2013).

The photoirradiation of 5-(2-benzo[b]thienyl)-5-ethoxy-5H-dibenzo[a,d]cycloheptene (**2**) in acetonitrile afforded a cage-like tetracyclic compound (**1**) via intramolecular $[2\pi + 2\pi]$ -photocycloaddition. The molecular and crystal structures of **1** and **2** were characterized by a single-crystal X-ray diffraction study. The formation of the cycloadduct is discussed in relation to the preferable conformation of the central C-C bond in **2**, which was revealed to be in restricted rotation on the basis of the temperature-dependent 1H NMR spectra.



Anti-UV Activity of Newly synthesized Water-soluble Azulenes

Jun-ichi Ueki, Hiroshi Sakagami*¹ and Hidetsugu Wakabayashi (*1 Department of Endodontics, Meikai University School of Dentistry)

International Journal of In Vivo Research, **27**, 119-126 (2013).

Background. We have previously reported that azulene-related compounds can protect the cells from UV-induced cytotoxicity. However, due to their high water insolubility, their anti-UV activity could not be accurately determined. In the present study, we newly synthesized a total of nine derivatives with higher water solubility, and re-investigated their anti-UV activity. **Materials and Methods.** Cytotoxicity of these compounds against three human normal oral and three human oral squamous cell carcinoma cell lines (OSCCs) was evaluated by 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) method. The concentration that reduced the viable cell number by 50% (CC_{50}) and the concentration that increased the viability of UV-irradiated cells to 50% (EC_{50}) were determined by the dose response curves. Anti-UV activity (SI) was determined by the ratio of CC_{50} to EC_{50} . The tumor specificity was determined by the ratio of the mean CC_{50} value for the normal cells to that for OSCC cells. Apoptosis induction was evaluated by DNA fragmentation and caspase activation. **Results:** All compounds except one (sodium 7-isopropyl-3-ethylazulene-1-sulfonate) were new compounds, and showed some tumor specificity (TS value = 1.4 to 3.5) without induction of hormesis or apoptosis at lower and higher concentrations, respectively. Sodium 3-methylazulene-1-sulfonate showed the highest tumor specificity and potent anti-UV activity, approximately one half that of sodium ascorbate, the positive control. **Conclusion:** These data suggest the possible applicability of newly synthesized water-soluble azulenes as skin care products protections from against UV irradiation.

Cytotoxic Activity of Benzo[*b*]cyclohept[*e*][1,4]oxazines

Masanori Ohno, Jun-ichi Ueki, Hiroshi Sakagami*¹ and Hidetsugu Wakabayashi (*1 Department of Endodontics, Meikai University School of Dentistry)

International Journal of In Vivo Research, **27**, 507-512 (2013).

Background. Although numerous papers have dealt with the biological activities of azulenes, studies of benzo[*b*]cyclohept[*e*][1,4]oxazines are limited. In the present study, we investigated a total of 14 newly synthesized benzo[*b*]cyclohept[*e*][1,4]oxazines for their growth stimulation at low concentrations (so-called 'hormesis'), cytotoxicity at higher concentrations and apoptosis-inducing activity. **Materials and Methods.** Cytotoxicity of these compounds against human normal gingival fibroblast (HGF) and human oral squamous cell carcinoma cell line derived from gingival tissue (Ca9-22) was evaluated by 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) method. The tumor specificity (TS) was determined by the ratio of the 50% cytotoxic concentration (CC_{50}) value for HGF cells to that for Ca9-22 cells. Apoptosis induction was evaluated by DNA fragmentation and caspase-3

activation. Results: Compounds 10-(3-methoxyethylamino)benzo[*b*]cyclohept[*e*][1,4]oxazine and 10-(3-methoxypropylamino)benzo[*b*]cyclohept[*e*][1,4]oxazine, but not other compounds, induced hormesis only in HGF cells. Compound 10-(3-hydroxyhexylamino)benzo[*b*]cyclohept[*e*][1,4]oxazine (**4**) showed the highest cytotoxicity against Ca9-22 cells, followed by 10-(3-hydroxybutylamino)benzo[*b*]cyclohept[*e*][1,4]oxazine and 10-(3-hydroxypentylamino)benzo[*b*]cyclohept[*e*][1,4]oxazine. Compound **4** did not induce apoptosis markers, but rather induced necrotic cell death (characterized by a smear pattern of DNA fragmentation). Conclusion: The present study suggests that the OH group and a certain length of methylene group are necessary for maximal cytotoxicity, and substitution of fluoride in the benzene ring enhances cytotoxicity.

Highly efficient green organic light-emitting diodes containing luminescent tetrahedral copper (I) complexes

Satoshi Igawa^{*1,*2}, Masashi Hashimoto, Isao Kawata^{*1,*3}, Masataka Yashima^{*1,*2}, Mikio Hoshino^{*1} and Masahisa Osawa^{*1}.

(*1 Luminescent Materials Laboratory, RIKEN, *2 Device Technology Development Headquarters, *3 Analysis Technology Center, Canon Incorporated)

J. Mater. Chem. C, **1**, 542-551 (2013).

A series of highly emissive sublimable copper(I) complexes with tetrahedral geometries were synthesized and investigated as luminescent guest molecules in organic light-emitting diodes. Thermogravimetric analysis of 1-3 under vacuum revealed that introduction of F or CF₃ substituents in the dppb skeleton increased the ability of the copper(I) complexes to be sublimed. 1-3 exhibited strong green emission in amorphous films at 293 K. Conventional bottom-emitting devices with three layer structures containing 3 produced bright green luminescence with maximum external quantum efficiency of 17.7%.

Application of neutral d10 coinage metal complexes with an anionic bidentate ligand in delayed fluorescence-type organic light-emitting diodes

Masahisa Osawa^{*1}, Isao Kawata^{*1,*3}, Ryuji Ishii^{*2}, Satoshi Igawa^{*1,*2}, Masashi Hashimoto and Mikio Hoshino^{*1,*2}.

(*1 Luminescent Materials Laboratory, RIKEN, *2 Device Technology Development Headquarters, *3 Analysis Technology Center, Canon Incorporated)

J. Mater. Chem. C, **1**, 4375-4383 (2013).

A series of heteroleptic coinage metal(I) complexes 1-3 were synthesized. X-ray crystallography demonstrated that 1-3 possessed tetrahedral structures containing two types of bidentate ligands, PP and PS. Photophysical studies and time-dependent density functional theory calculations indicated that the emission from 1-3 in the solid state at room temperature originated from thermally activated delayed fluorescence. Cu(I) complex 1, which exhibited

efficient green TADF with a maximum emission wavelength of 521 nm and a quantum yield of 0.52 in the solid state, was used to fabricate TADF-type organic light-emitting diodes via a wet process.

2. Books, Reviews and Other Printings

MATHEMATICS

Clifford Quartic forms から得られる局所関数等式

小木曾岳義

数理解析研究所講究録 1877, 「表現論および表現論の関連する諸分野の発展」, pp. 70-87

On homaloidal polynomial functions of degree 3 and prehomogeneous vector spaces

Math.sci.net review MR3016638 Reviewed Chaput, Pierre-Emmanuel; Sabatino, Pietro, On homaloidal polynomial functions of degree 3 and prehomogeneous vector spaces. *Collect. Math.* **64** (2013), no. 1, 135-140 (Reviewer: Takeyoshi Kogiso) 14E05 (11890).

b -functions and the representation theory of quivers

Math.sci.net review MR3077282 Reviewed Sugivama, Kazunari b -functions and the representation theory of quivers. New developments in group representation theory and non-commutative harmonic analysis, 1-16. *RIMS Kokyuroku Bessatsu*. **B36**, Res. Inst. Math. Sci. (RIMS), Kyoto, 2012 (Reviewer: Takeyoshi Kogiso) 11890 (16G20 20G05)

Universal transitivity of reductive prehomogeneous vector spaces with a finite number of orbits

Math.sci.net review MR2966844 Reviewed Ryu, Inhyun Universal transitivity of reductive prehomogeneous vector spaces with a finite number of orbits. *J. Algebra* **370** (2012), 361-386 (Reviewer: Takeyoshi Kogiso) 11890 (20G05)

On a classification of 3-simple prehomogeneous vector spaces with two irreducible components

Math.sci.net review MR 2976555 Reviewed Kurosawa, Yoshiteru On a classification of 3-simple prehomogeneous vector spaces with two irreducible components. *Tsukuba J. Math.* **36** (2012), no. 1, 135-172. (Reviewer: Takeyoshi Kogiso) 20G05 (11890)

On prehomogeneity of a rank variety

Math.sci.net review MR2957202 Reviewed Ouchi, Masaya; Hamada, Michio; Kimura, Tatsuo On prehomogeneity of a rank variety. *Proc. Amer. Math. Soc.* **140** (2012), no. 12, 4127-4129. (Reviewer: Takeyoshi Kogiso) 11S90 (15A03)

表現論とのかかわり

大島利雄

特集「表現論の世界」, 編集責任者, 数理科学, p. 5-6, サイエンス社 (2013).

多項式係数の線型常微分方程式

大島利雄

日本数学会秋季総合分科会, 総合講演アブストラクト, pp. 10, 日本数学会 (2013).

Signed actions of finite hypergroups and the extension problem (English, Japanese summary)

Kawakami, Satoshi; Sakao, Masafumi; Tsurii, Tatsuya; Yamanaka, Satoe *Bull. Nara Univ. Ed. Natur. Sci.* **61** (2012), no. 2, 13-24. 43A62 (20N20) MathSciNet MR3087416 (Reviewer : Masatoshi Iida)

CHEMISTRY

基礎物理化学演習 第2版

尾崎 裕, 末岡一生, 宮前 博, 見附孝一郎

三共出版 pp. 1-195, (2013)

PHYSICAL EDUCATION

ワールドカップバレーボール 2011 出場選手の身体的特徴と競技能力に関する研究

田中信雄^{*1}, 村上博巳^{*1}, 明石正和 (*1 京都産業大学文化学部)

城西大学研究年報・自然科学編, 第 36 巻, 2013 年 3 月, pp. 9-26

大学バレーボール選手のスポーツビジョンに関する研究 ― 性差と貢献度 ―

村上博巳^{*1}, 山本武司^{*2}, 増田 洋^{*3}, 明石正和, 田中信雄^{*1} (*1 京都産業大学文化学部, *2 京都華頂大学, *3 京都嵯峨芸術大学)

城西大学研究年報・自然科学編, 第 36 巻, 2013 年 3 月, pp. 27-44

3. Oral Presentations

MATHEMATICS

Representations of Clifford algebras and local functional equations

Takeyoshi Kogiso

九州大学表現論セミナー（九州大学伊都キャンパス），福岡，2013 年 3 月

非概均質的局所関数等式について

小木曾岳義

早稲田大学整数論セミナー（早稲田大学西早稲田キャンパス），東京，2013 年 5 月

Clifford quartic forms and nonprehomogeneous local functional equations

小木曾岳義

数理解析研究所研究集会「Development of Representation Theory and its Related Fields」（京都大学数理解析研究所），京都，2013 年 6 月

Castling transforms of prehomogeneous vector spaces and Markoff numbers

小木曾岳義

The eighth international conference on Nonlinear Analysis and Convex Analysis
2013（弘前大学），弘前，2013 年 8 月

Representations of Clifford algebras and local functional equations

小木曾岳義

JSPS-XWO Seminar（日本オランダ二国間交流共同ゼミナール）Analysis, Geometry and Group
Representations for Homogeneous Spaces（名古屋大学），名古屋，2013 年 8 月

EKP-homaloidal function について

小木曾岳義

表現論ワークショップ（京都大学），京都市，2013 年 9 月

乗法的 Legendre 変換と局所関数等式

小木曾岳義

日蘭セミナー整理会（九州大学），福岡市，2013 年 9 月

2次元シンプレクティック・ベクトル空間内の代数曲線に対する Deligne-Simpson 問題

大島利雄

代数幾何講演会，埼玉大学理学部，2013 年 2 月

代数的線型常微分方程式の古典極限

大島利雄

アクセサリー・パラメーター研究会，熊本大学，2013 年 3 月

微分方程式をめぐって

大島利雄

東京大学数理科学研究科談話会，2013 年 3 月

微分方程式と代数曲線

大島利雄

幾何学とインターネット，上原国際セミナーハウス，2013 年 7 月

Linear differential equations on the Riemann sphere

T. Oshima

Formal and Analytic Differential, Difference and Discrete Equations, Bedlewo, Poland, 2013 年 8 月

Some fundamental lemmas for linear ordinary differential equations

T. Oshima

Global Study of Differential Equations in the Complex Domain, Polish-Japanese research group, Banach Center, Poland, 2013 年 9 月

Singularities of first order nonlinear partial differential equations and contact geometry

T. Oshima,

Global Study of Differential Equations in the Complex Domain, Polish-Japanese research group, Banach Center, Poland, 2013 年 9 月

Appell の超幾何と fractional calculus

大島利雄

玉原アクセサリー・パラメータ研究会，玉原国際セミナーハウス，2013 年 9 月

福原による漸近解の構成について

大島利雄

アクセサリー・パラメータ研究会, 玉原国際セミナーハウス, 2013 年 9 月

多項式係数の線型常微分方程式

大島利雄

日本数学会秋季総合分科会, 総合講演, 愛媛大学, 2013 年 9 月

多変数超幾何と rigidity

大島利雄

群と幾何学の展望, 玉原国際セミナーハウス, 2013 年 10 月

数式処理による数学研究とプレゼンテーション

大島利雄

数式処理とその周辺分野の研究, 特別講演, 京都大学数理解析研究所, 2013 年 12 月

Convergence results in order-preserving systems and its applications to reaction-diffusion systems

Toshiko Ogiwara

Mathematical Modelling and Analysis in the Life Sciences, Carry-le-Rouet (France), 2013 年 6 月

順序保存力学系と生物分子モーターモデルへの応用

萩原俊子

第 23 回日本数理生物学会大会企画シンポジウム: 拡散現象の数学理論と生物モデルへの応用, 静岡大学, 2013 年 9 月

Construction of infinite product possibility space [不確実性の下での数理的意決定の理論と応用]

M. Kageyama, T. Yamauchi and K. Iwamura

京都大学数理解析研究所, 2013 年 11 月

PHYSICS

電荷移行反応における Fraunhofer 回折の測定可能性

伊藤 陽

原子衝突学会, 第 38 回年会 (理化学研究所) 2013 年 11 月, 講演概要集 p.36

CHEMISTRY

メタノールアミンの構造に関する理論的研究

寺前裕之, 丸尾容子^{*1} (*1 東北工大工)

日本コンピュータ化学会 2013 年春季年会 (東京), 2013 年 5 月, 講演要旨集 2P08

ルチジン誘導体生成の反応機構に関する理論的研究 (3)

石川 諒, 寺前裕之, 丸尾容子^{*1} (*1 東北工大工)

日本コンピュータ化学会 2013 年春季年会 (東京), 2013 年 5 月, 講演要旨集 2P13

分子軌道法による HF, LiH, HeH⁺ の双極子モーメント

寺前裕之, 長岡伸一^{*1}, 長嶋雲兵^{*2} (*1 愛媛大院理, *2 産総研)

第 16 回理論化学討論会 (福岡), 2013 年 6 月, 講演要旨集 2P36

水分子を付加したメタノールアミン構造に関する理論的研究

寺前裕之, 丸尾容子^{*1} (*1 東北工大工)

第 7 回分子科学討論会 (京都), 2013 年 9 月, 講演要旨集 2P114

メタノールアミンの構造に関する理論計算

寺前裕之, 丸尾容子^{*1} (*1 東北工大工)

日本コンピュータ化学会 2013 年秋季年会 (福岡), 2013 年 10 月, 講演要旨集 1P06

ルチジン誘導体の反応機構に関する理論的研究 (4)

石川 諒, 寺前裕之, 丸尾容子^{*1} (*1 東北工大工)

日本コンピュータ化学会 2013 年秋季年会 (福岡), 2013 年 10 月, 講演要旨集 2P05

プロトン化水クラスターのグラフ表示と安定構造の網羅的探索

赤瀬 大^{*1}, 相田美砂子^{*1}, 寺前裕之 (*1 広島大院理)

第 36 回情報化学討論会 (つくば), 2013 年 11 月, 講演要旨集 P4

Theoretical study on the structures of ethanolamine and its CO₂ complexes using the Hamiltonian algorithm

Hiroyuki Teramae, Yasuko Y. Maruo^{*1} (*1 Tohoku Institute of Technology)

APCTCC 6 (Gyeongju, Korea), July 2013, PS21 (S-A)

Theoretical study on ethanolamine-water complex and ethanolamine dimer using Hamiltonian algorithm

Hiroyuki Teramae, Yasuko Y. Maruo^{*1} (*1 Tohoku Institute of Technology)

5-th JCS International Symposium on Theoretical Chemistry (Nara), December 2013, PIIa-10 (invited poster)

二重試料高分解能赤外発光分光による DCI スペクトルの観測と non-Born-Oppenheimer 解析

坂本幸博, 勝家俊介, 堀合公威, 上原博通

第 7 回分子科学討論会 (京都), 2013 年 9 月, 2P004

二重試料高分解能赤外発光分光による AID スペクトルの観測と non-Born-Oppenheimer 解析

矢部辰翔, 堀合公威, 上原博通

第 7 回分子科学討論会 (京都), 2013 年 9 月, 2P005

二重試料高分解能赤外発光分光による GaH スペクトルの観測と non-Born-Oppenheimer 解析

伏見直樹, 石塚雅直, 堀合公威, 上原博通

第 7 回分子科学討論会 (京都), 2013 年 9 月, 3P003

希ガス-C¹⁶O¹⁸O 錯体の赤外ダイオードレーザー分光

渋谷 健, 紺野東一, 尾崎 裕

第 7 回分子科学討論会 (京都), 2013 年 9 月

希ガス-シクロアルカン van der Waals 錯体の構造の量子化学計算

宮川 肅, 紺野東一, 尾崎 裕

第 7 回分子科学討論会 (京都), 2013 年 9 月

酸化チタンナノ粒子 P25, P90 及びイオン液体を含む電解液から構成される色素増感太陽電池の製作

野村咲子, 佐藤 陸, 見附孝一郎

日本化学会第 93 春季年会 (草津), 2013 年 3 月, 講演要旨集, 2PD-011

光電変換電極に用いる酸化亜鉛ナノロッドの合成と評価

美内 優, 見附孝一郎, Hong Quang Le^{*1} (*1 Institute of Materials Research and Engineering, Singapore)

日本化学会第 93 春季年会(草津), 2013 年 3 月, 講演要旨集, 2PD-016

Development and evaluation of carbon nanotube counter electrodes for dye-sensitized solar cells

Hideki Katayanagi^{*1}, Kenta Shida, Koichiro Mitsuke (*1 Institute for Molecular Science)

29th Symposium on Chemical Kinetics and Dynamics (Sendai), 2013 年 6 月, Book of Abstracts, 2P43

有機系太陽電池カウンター電極に用いる白金ナノ粒子の合成と評価

古郡 玲, 河野 陸, 見附孝一郎, 秋田素子

第 7 回分子科学討論会(京都), 2013 年 9 月, 講演要旨集, 2P041

High performance dye sensitized solar cells based on multilayered structure of P90 and P25 titania nanoparticles

Deepak Bashyal^{*1}, Masakazu Ito, Koichiro Mitsuke (*1 Institute for Molecular Science)

第 7 回分子科学討論会(京都), 2013 年 9 月, 講演要旨集, 2C21

化学と人間社会のつながり ― 物質とエネルギーの探求の歴史 ―

見附孝一郎

城西大学公開講座(坂戸), 2013 年 9 月

イオン液体を含む電解液で構成される色素増感太陽電池の性能評価

伊藤秀明, 野村咲子, バシユアル ディパック^{*1}, 見附孝一郎 (*1 Institute for Molecular Science)

第 4 回イオン液体討論会 (日吉), 2013 年 11 月, 講演要旨集, 1P26

ビス{トリス(2,2'-ビピリジン)鉄(II)}トリス(オキサラト)コバルト(III)臭化物・n 水和物の合成

益子志織, 日原五郎, 宮前 博

錯体化学第 63 回討論会(沖縄), 2013 年 11 月, 講演要旨集, 2PA-060.

Screening of calamus genes of pigeon feather keratin

高橋理恵子

第 86 回日本生化学会大会 (横浜), 2013 年 9 月, 講演要旨集, p. 150

Relationship between splicing of the transcripts and activity of the enzyme at the *AcpH* locus in the Japanese population of *Drosophila virilis*

Hiroko Kitagawa

Joint Conference of HGM 2013 and 21st International Congress of Genetics (Singapore), April 2013, Abstracts p.318

魚類の 2 つの進化系統において異なった運命をたどった孵化酵素の重複遺伝子

佐野香織, 川口眞理^{*1}, 渡部諭史^{*2}, 安増茂樹^{*1} (*1 上智大理工, *2 国際農研セ)

日本進化学会第 15 回大会 (つくば), 2013 年 8 月, 講演要旨集, 1B-01

ニシンの卵膜の 2 層構造 — 卵巣由来と肝臓由来の卵膜 —

佐野香織, 川口眞理^{*1}, 富田憲司^{*2}, 安増茂樹^{*1} (*1 上智大理工, *2 東大院農)

日本動物学会第 84 回大会 (岡山), 2013 年 9 月, 講演要旨集, 2B0915

アカハライモリ胃部域アスパラギン酸プロテアーゼのクローニング

長澤竜樹^{*1}, 佐野香織, 川口眞理^{*1}, 小林健一郎^{*1}, 安増茂樹^{*1}, 井口智文^{*2} (*1 上智大理工, *2 宇都宮大教育)

日本動物学会 第 84 回大会 (岡山), 2013 年 9 月, 講演要旨集, 1L1330

Genetic population structure of the fourspine sculpin, *Cottus kazika* inferred from mitochondrial DNA control region haplotypes

石黒直哉, 田原大輔^{*1} (*1 福井県大海洋生資)

第 9 回インド・太平洋魚類学会議 (沖縄), 2013 年 6 月

mtDNA 調節領域におけるヤマノカミの遺伝的多様性

石黒直哉, 藤田健太郎, 田原大輔^{*1}, 竹下直彦^{*2} (*1 福井県大海洋生資, *2 水大校)

日本魚類学会第 46 回年会(宮崎), 2013 年 10 月

越前市西部地域に生息するドジョウの遺伝的特性

日和佳政^{*1}, 新井文八, 藤長裕平^{*1}, 石黒直哉, 鈴木克欣^{*2}, 田原大輔^{*3} (*1 越前市産業環境部, *2 福井県大海洋生資, *3 福井県土地改良事業団体連合会)

日本 DNA 多型学会第 22 回学術集会 (仙台), 2013 年 11 月

福井県に生息するドジョウの遺伝的特性

石黒直哉, 持田宇晃, 日和佳政^{*1}, 藤長裕平^{*1}, 田原大輔^{*2} (*1 越前市産業環境部, *2 福井県大海洋生資)

日本 DNA 多型学会第 22 回学術集会 (仙台), 2013 年 11 月

Distinctive bioimaging with luminescent quantum dots and plasmonic nanoparticles

Ishikawa, M.

The 7th International Conference on Materials for Advanced Technologies (ICMAT2013), June-July 2013, Subtec, Singapore (Invited Talk)

Evaluation of plasmonic enhancement and fluctuation in surface-enhanced Raman scattering and surface-enhanced fluorescence

T. Itoh^{*1}, Y. S. Yamamoto^{*1}, M. Iga^{*1}, H. Tamaru^{*2}, V. Biju^{*1}, M. Ishikawa, Y. Ozaki^{*3} (*1 Health Research Institute, AIST, Shikoku^{*2}, Department of Applied Physics, The University of Tokyo^{*3}, Department of Chemistry, Kwasei Gakuin University)

7th International Conference on Advanced Vibrational Spectroscopy (ICAVS 7), August 2013, Kobe, Japan

発光性金量子ドットの作製とナノ光物性の評価

宇和田貴之, 渡部建佑, 石川 満

2013 年光化学討論会(松山), 2013 年 9 月, 1P022.

Spectroscopic investigation of highly fluorescent protein-encapsulated Au clusters

Takayuki Uwada

International Conference on Photochemistry 2013 (Leuven, Belgium), 2013 年 7 月, p. 18.

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